



# INTEGRATED PEST MANAGEMENT

## Unit 3 Lesson 3 E<sup>3</sup> - Earth's Endangered Ecosystems

**Focus Areas:** Biodiversity; Science,  
Language Arts, Graphic Arts, Social  
Studies

**Focus Skills:** Reading expository  
material, summarizing, oral presentation,  
evaluating, understanding maps,  
cooperative learning

**Level of Involvement:** MINIMAL

Unit 3 Lesson 3:  
E<sup>3</sup> - Earth's Endangered Ecosystems





**Dedicated  
to Reducing  
Pesticides**



**University of  
Connecticut**  
College of Agriculture  
and Natural Resources  
Cooperative Extension System

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**H I P P O  
= Habitat Loss**

### Objectives

- \* To recognize and evaluate threats to world ecosystems
- \* To increase community awareness regarding the need for positive action to preserve our ecosystems
- \* To investigate Connecticut's specific ecological problems

### Essential Questions

- \* How are the world's ecosystems being threatened?
- \* Why should this threat concern me?

### Essential Understanding

Every ecosystem worldwide is currently threatened to varying degrees by pollution, overpopulation, overconsumption, habitat loss and invading species.

### Background

Read article *Condition Critical*.

### Vocabulary



**ecosystem**

naturally occurring habitats possessing unique populations and natural features



## Unit 3 Lesson 3: E<sup>3</sup> - Earth's Endangered Ecosystems

### Challenge

Investigate an endangered ecosystem and evaluate the threats

#### Logistics

**Time:** two 45-minute periods

**Group size:** a number divisible by 5 is optimal

**Space:** comfortable seating for five teams to include room to write, discuss and develop visuals

#### Materials

ecosystem world map poster

Article *Condition Critical* \*

Handout 1 \*

ecosystem world map (individual copy)

ecosystem cards (team Handout 3) \*

materials to create posters

Assessment for an Illustration/Poster \*

\* single copy provided



#### Preparations

Make copies of individual and team materials including assessment.

### Activity

#### Introduction

1. Brainstorm with group the meaning of the term ecosystem.
2. Brainstorm and list ecosystems of the world.
3. Introduce the concept that all ecosystems can be classified as 1 of 5 ecosystems.
4. Combine and/or eliminate from the list to create 5 major classifications.
5. Examine maps to determine location of ecosystems worldwide.
6. Read Handout 1 aloud.



## Unit 3 Lesson 3: E<sup>3</sup> - Earth's Endangered Ecosystems

### Activity

#### Involvement

1. Divide the group into teams of 5 and assign an ecosystem to each member.
2. Distribute ecosystem cards and allow time to read silently.
3. Have each team member define the ecosystem and summarize the problems facing the ecosystem he/she researched.
4. The teams discuss problems and order them from most to least serious.
5. Teams reach consensus on which ecosystem is the most endangered based on their ordering.

### Follow Up

1. The teams share their findings and reasons for choices.
2. The group discusses and votes on which ecosystem is most threatened.

### Answer Key

none needed



## Unit 3 Lesson 3: E<sup>3</sup> - Earth's Endangered Ecosystems

### Assessment

#### Option #1

The teams create a series of three public service ads to raise public awareness regarding the threats to the ecosystem that they researched. **Note:** Regroup by ecosystem.

#### Option #2

Apply the ad campaign to the Connecticut region in which the group lives.

### Follow Through

**Focus Areas:** Science, Social Studies

**Focus Skills:** Comparison and contrast

**Additional Materials:** Maps of local region (historic and current)

1. The group examines maps of Connecticut and local area maps both current and past to determine what threats are posed in the area in which they live.
2. The group discusses what has been done and what more can be done.



### Resources

<http://www.nationalgeographic.com/wildworld/terrestrial.html>



## Unit 3 Lesson 3: E<sup>3</sup> - Earth's Endangered Ecosystems

### Notes



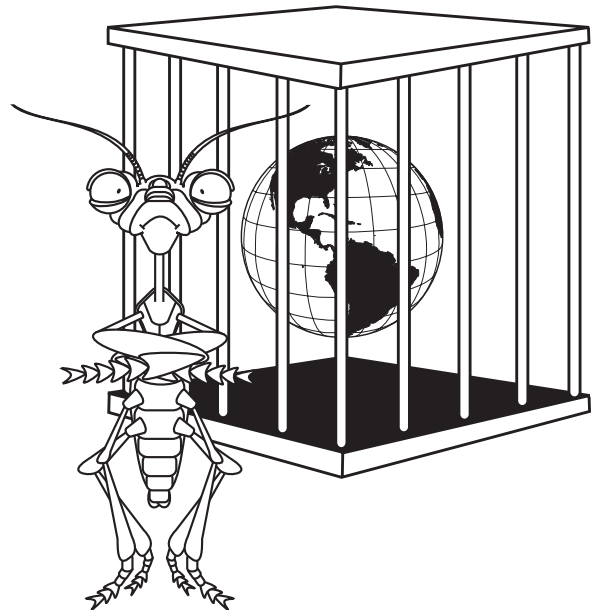
## Unit 3 Lesson 3: E<sup>3</sup> - Earth's Endangered Ecosystems

### Notes



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## Unit 3 Lesson 3: E<sup>3</sup> - Earth's Endangered Ecosystems

### Handout 1

**For more than 40 years, Earth** has been sending out distress signals. At first they were subtle, like the thin shells of bald-eagle eggs that cracked because they were laced with DDT. Then the signs were unmistakable, like the pall of smoke over the Amazon rain forest, where farmers and ranchers set fires to clear land. Finally, as the new millennium drew near, it was obvious that Earth's pain had become humanity's pain. The collapse of the North Atlantic cod fishery put 30,000 Canadians out of work and ruined the economies of 700 communities. Two years ago, deforestation worsened China's floods, which killed 3,600 people and left 14 million homeless. Population pressures and overcrowding raised the toll from last year's rains in Latin America, which killed more than 30,000 people and created armies of environmental refugees.

How have we responded to four decades of ever-louder distress signals? We've staged a procession of Earth Days, formed Green parties, passed environmental laws, forged a few international treaties and organized global gabfests and photo ops like the 1992 Earth Summit in Rio de Janeiro. All the while, the decline of Earth's ecosystems has continued unabated.

What will it take for us to get serious about saving our environment? When will environmentalism move from being a philosophy promoted by a passionate minority to a way of life that governs mainstream behavior and policy? How can we understand that Earth is one big natural system and that burning tropical rain forests and destroying coral reefs will eventually threaten the well-being of towns and cities everywhere?



## Unit 3 Lesson 3: E<sup>3</sup> - Earth's Endangered Ecosystems

### Assessment for an Illustration/Poster

Criteria	Possible Points	Points Earned
1. The topic is clearly addressed in drawing.	_____	_____
2. All details contribute to the purpose and theme.	_____	_____
3. Appropriate details are shown accurately.	_____	_____
4. The drawing/poster is correctly labeled.	_____	_____
5. The drawing/poster is easily understood.	_____	_____
6. Space is used well.	_____	_____
7. The drawing/poster is neatly done.	_____	_____

**Comments:**

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# CONDITION CRIT

**F**OR MORE THAN 40 YEARS, EARTH has been sending out distress signals. At first they were subtle, like the thin shells of bald-eagle eggs that cracked because they were laced with DDT. Then the signs were unmistakable, like the pall of smoke over the Amazon rain forest, where farmers and ranchers set fires to clear land. Finally, as the new millennium drew near, it was obvious that Earth's pain had become humanity's pain. The collapse of the North Atlantic cod fishery put 30,000 Canadians out of work and ruined the economies of 700 communities. Two years ago, deforestation worsened China's floods, which killed 3,600 people and left 14 million homeless. Population pressures and overcrowding raised the toll from last

year's rains in Latin America, which killed more than 30,000 people and created armies of environmental refugees.

And how have we responded to four decades of ever louder distress signals? We've staged a procession of Earth Days, formed Green parties, passed environmental laws, forged a few international treaties and organized global gabfests and photo ops like the 1992 Earth Summit in Rio de Janeiro. All the while, the decline of Earth's ecosystems has continued unabated.

What will it take for us to get serious about saving our environment? When will environmentalism move from being a philosophy promoted by a passionate minority to a way of life that governs mainstream behavior and policy? How can we understand that Earth is one big

natural system and that torching tropical rain forests and destroying coral reefs will eventually threaten the well-being of towns and cities everywhere?

One crucial step is a true accounting of the state of the planet, a thorough assessment of the health of all Earth's major ecosystems, from oceans to forests. Only a comprehensive global survey can show how damage to one system is affecting other systems and can determine whether Earth as a whole is losing its ability to nurture the full diversity of life and the economies of nations.

That was the thinking behind the launching of the most ambitious study of global ecosystems ever undertaken. In September, at a special millennial session of the U.N., four of its agencies and partners—the World Bank, the

## THE FRAYING WEB OF LIFE

*The new U.N. report examines the state of knowledge about five major categories of ecosystems, scoring them in terms of their capacity to continue to deliver the goods and services that support life and human economies. It looks at how people have altered ecosystems and affected their robustness, and where trouble might lie in the future.*

TIME GRAPHICS  
BY LON TWEETEN

## COASTAL/MARINE

Home to 2 billion people, coastal areas play a vital economic role and also feel the full brunt of human impact. Two-thirds of all fish harvested depend at some point in their lives on coastal wetlands, seagrasses or coral reefs, all of which are fast disappearing.



### OUTLOOK

The catch is declining for about one-third of major commercial fish. Collapsing fisheries will directly hurt 1 billion people, particularly in Southeast Asia.

GRIM ——— GOOD

### Pollution

Toxic and nutrient runoffs have produced a rash of algal blooms

### Overfishing

Fleets are 40% larger than oceans can sustain

### Climate change

Warming waters are causing coral reefs to die

### Trawling

Destroys vast areas of sea floor





# TICAL

An exclusive look at a U.N. assessment of Earth's ecosystems shows they are strained to the limit

By Eugene Linden

U.N. Development Program, the U.N. Environment Program and the World Resources Institute—will present the first results of this project, a Pilot Analysis of Global Ecosystems. The findings of the \$4 million study, called PAGE for short, will be published in the 2000-01 edition of the *World Resources Report* titled *People and Ecosystems: The Fraying Web of Life*. PAGE will also set the stage for a larger \$20 million Millennium Ecosystem Assessment, scheduled to begin next year. The goal is to answer the most important question of the century: What is happening to Earth's capacity to support nature and civilization?

TIME was given an exclusive advance look at the U.N. report, which makes for sobering reading. Its conclusions are di-

vided into assessments of five major types of ecosystems—forests, freshwater systems, coastal/marine habitats, grasslands and agricultural lands—and all five are showing signs of deterioration (see the graphics on these pages). The report's maps and charts capture the stunning scale and character of human impact on the planet. One set reveals the degree to which agricultural lands have been degraded around the world by the buildup of salts and the loss of nutrients; another locates oceanic dead zones caused by pollutants flowing to the sea from rivers; another shows the degree to which productive parts of the sea floor have been destroyed by trawling; another highlights how much humanity has altered coastlines. Many of the statistics are staggering: half the world's wetlands have

been lost in the past century; 58% of coral reefs are imperilled by human activity; 80% of grasslands are suffering from soil degradation; 20% of drylands are in danger of becoming deserts; and groundwater is being depleted almost everywhere.

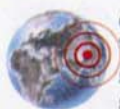
But as dramatic as these numbers are, will PAGE accomplish anything? The U.N. has a reputation for studying problems as a substitute for doing something about them. Its agencies churn out paper the way ragweed produces pollen, and most U.N. studies quickly disappear into file-cabinet oblivion in the offices of other paper shufflers. Moreover, after decades of conferences on environment and sustainable development, the natural response to such an assessment is, "Hasn't someone already done this?"

No, nothing this sweeping. PAGE brought together 175 scientists from many disciplines and nations. They drew upon, reanalyzed and integrated the data collected in roughly 100 prior assessments and studies of various ecosystems and regions. They also pored over new findings collected through satellite imaging and other forms of remote sensing. The purpose was to identify gaps in information, target critical areas deserving attention and pinpoint likely trouble spots in the future.

The results provide an overwhelming case for proceeding with the full-scale assessment next year. Equally important, PAGE is the first time a critical

## FRESHWATER

These are the most critical of ecosystems since all organisms need water to survive. Human water consumption rose sixfold in the past century, double the rate of population growth. People now use 54% of available freshwater, and additional demand will further jeopardize all other ecosystems.



### OUTLOOK

Water scarcity may soon limit economic development, particularly in parts of **China**, where supplies are already inadequate to meet the needs of people, industry and agriculture.



### Pollution

Fertilizers, silts, sewage and other effluents have killed lakes and poisoned rivers

### Conversion, diversion and fragmentation

Half the world's wetlands have been drained, destroying habitat

### Overuse

So much water has been taken from rivers like the Colorado, Yellow and Ganges that they sometimes dry up before reaching the sea

### Invasions

Introduction of nonnative species into an environment disrupts the existing balance. Zebra mussels, left, introduced into the Great Lakes from the Caspian, have clogged water-supply systems



Sources: U.N. and partners. Outlook ratings by TIME, based on PAGE assessment



### Extinction

Biodiversity is more endangered in freshwater than in any other ecosystem



mass of scientists from different disciplines has rallied around the crisis in the planet's ecosystems. Notes Cales-tous Juma of Harvard's Kennedy School of Government: "If you look at issues like ozone depletion and climate change, there was progress because different scientists pulled together in assessments. That hasn't happened until now in biological systems."

#### NATURE THE PRODUCER

What really distinguishes *PAGE* is its approach. It's significant that two of the sponsoring agencies—the U.N. Development Program and the World Bank—deal primarily with economic development. Their participation acknowledges an inescapable fact: economies cannot remain forever healthy in an unhealthy environment. *PAGE* looks at the natural world in a new way: not just as a beautiful place that should be preserved for aesthetic or moral reasons but also as an economic asset that delivers irreplaceable goods and services. Ecosystems temper climate, purify and store water, recycle wastes, produce food and support all the other things that make Earth a friendly oasis in a stark and lonely universe. Despite the universally acknowledged importance of these life-creating natural networks, until now no organization has undertaken a global assessment of Earth's capacity to continue delivering goods and services.

*PAGE* starkly concludes that our planet's capacity is beginning to diminish, threatening our economic well-being and ultimately our survival. It's not possible to go through the report's maps, charts, graphs and case studies without wondering, How did we let things get to this point?

The answer lies in a paradox. No one argues that life on Earth would be possible without ecosystems, but the entire march of human progress has occurred against a backdrop of landscapes transformed from their natural state to suit the needs of agriculture and industry. Various societies have degraded huge areas without suffering dire consequences. In the U.S., pioneers plowed up almost the entire prairie on the nation's way to becoming an agricultural and economic colossus, but America lost what may have been the greatest concentration of animal life on the planet. Britain, Japan, Korea and Thailand are among the societies that prospered even as they converted their original natural systems into farms and industrial parks, diverted and despoiled their rivers and re-engineered their coasts.

The world needs ecosystems, but apparently not every ecosystem, everywhere. The genius of the market economy is that it enables a nation to buy from other places or re-create through technology some of the benefits once derived

from the local habitat. The genius of nature is that ecosystems can absorb shocks and sustain damage and still rebound.

#### OUTSTRIPPING CAPACITY

One reason governments have been slow to respond to the environmental crisis is that Earth is still churning out plenty of goods—enough fiber, grain and fish to support 6 billion people. Many are malnourished, of course, but that's primarily a matter of bad distribution. A closer look at the trends, though, is disturbing. *PAGE* points out that there is a difference between current production and capacity, which is the amount of grain or fish the globe can produce indefinitely. Fishing fleets, the report says, are 40% larger than the ocean can sustain. At that rate, more fisheries are bound to collapse, as did the North Atlantic cod grounds. We're borrowing heavily from our children's future.

Consider the situation in Africa's Lake Victoria. A superficial look at production shows a rosy picture of a giant lake producing 300,000 metric tons of Nile perch and tilapia annually, yielding roughly \$300 million in the export market. The two fish are not native, however, and introducing these species has jeopardized the dynamics of Africa's largest lake. The invaders have crowded out 350 species of native cichlid fish that used to support the local fishermen, most of whom cannot afford the equip-

## AGRICULTURAL LANDS

One-third of global land has been converted to food production, but three-quarters of this area has poor soil. So far, harvests outpace population growth, but the future is clouded by the loss of land to urban development, soil degradation and water scarcity.



#### OUTLOOK

More than 40% of agricultural land has been badly degraded. Erosion, nutrient depletion and water stress spell trouble for such places as **Latin America**.

GRIM ——— GOOD

#### Fertilizers and pesticides

Chemicals kill helpful creatures, taint groundwater and create dead zones in the oceans

#### Soil degradation

Improper farming causes nutrient loss

#### Irrigation

The process taxes aquifers, drains rivers and can lead to ruinous salt buildup in soil



## GRASSLANDS

This system, which covers 40% of the world's land surface, includes savannas, shrublands and tundra. It supports the largest mammals, migrating birds, crops and livestock. All human food grains originated in grasslands, and wild strains of these staples help keep crops resistant to threats.



#### OUTLOOK

The **U.S.** has lost almost all its original grassland. Elsewhere, soil erosion and desertification are reducing the ability of the system to support livestock.

GRIM ——— GOOD



ment necessary to fish for perch. With the cichlid population reduced more than 80%, malnutrition is more evident in surrounding villages, even as the export market booms.

The perch-tilapia takeover has upset the system in other ways as well. Without the cichlids moving up and down the lake and mixing the waters, some layers of the lake are becoming stratified and depleted of oxygen. Algal blooms, fed by pollution

habitats. Since humans already use more than half the available freshwater on the planet, and two-thirds of all agricultural lands is damaged to some degree, we face an enormous challenge merely to feed the 1.5 billion to 2 billion people expected to join the global population within the next two decades.

With so much at stake, you would expect nations to make the monitoring of ecosystem capacity a priority. In fact,

in mountains can worsen floods in grasslands or agricultural lands below, as was the case in China and more recently in Madagascar. Humans have hurt coastal/marine ecosystems directly by draining wetlands, cutting mangroves, trawling oceans for fish and destroying reefs and lagoons. But we also damage these ecosystems indirectly as rivers transport to the coasts the effluents and by-products of agriculture, industry, urban areas, logging and dams. As if all that weren't enough, man-made climate change threatens all coastal areas, as melting glaciers send more water seaward and the warming and expanding of the oceans cause sea levels to rise. Coastal cities may someday be inundated, and entire islands could disappear beneath the waves.

## IT'S NOT POSSIBLE TO LEAF THROUGH THE CHARTS, MAPS AND CASE STUDIES WITHOUT WONDERING: HOW DID WE LET THINGS GET TO THIS POINT?

and agricultural runoff, are increasing. All these changes have taken place in just 20 years. Now they are coming full circle; the lake's instability threatens the perch and tilapia fishery.

Every ecosystem suffers from the kind of unintended consequences that jeopardize Lake Victoria. Shrimp farmers cut mangroves in Thailand, Ecuador and on other tropical coastlines, unaware that their increased production comes at the expense of offshore fishermen who catch fish nurtured in mangroves. Since 1970, global food output has doubled and livestock production tripled, but the trade-offs have been depleted, polluted water supplies, exhausted soils and destroyed

another disturbing PAGE finding is that in many cases, the gap between what scientists need to know and what is available is widening, not shrinking. Access to satellite data has improved mapping of broad areas, but the report asserts that on-the-ground reporting on issues like water quality has decreased in the past 20 years. Indeed, the biggest gaps in information concern freshwater and coastal/marine ecosystems, which are in the worst shape and arguably the most vital for human well-being.

It is difficult enough to assess an ecosystem, but policymakers also need to understand how various ecosystems interact. Deforestation

### UPSETTING THE SYSTEM

Anyone who has taken a general-science course knows that Earth's most important elements move in cycles, circulating from sky to land and sea and back again. The human presence has become so



## FORESTS

Home to two-thirds of all species, forests temper climate and capture and store water. Their timber has been a springboard for economic development. Forests store 40% of terrestrial carbon, and can slow the buildup of carbon dioxide in the atmosphere.



### OUTLOOK

Except for Russia and Canada, industrial nations have cleared almost all their original forests. Rain forests are also rapidly shrinking. Most at risk is the **Pacific Rim**.

GRIM ——— GOOD





dominant that we have disrupted even these most basic mechanisms of the planet. Most familiar, of course, is what we have done to the carbon cycle. Because we are pumping carbon dioxide into the atmosphere much faster than land and seas can reabsorb it, the accumulating gas is trapping heat and upsetting the climate. The result is not only rising seas and fiercer storms but also a possible repositioning of the world's ecosystems as the boundaries of forests or grasslands shift. Many animal and plant species may not be able to adjust to sudden changes in their habitats.

Less familiar is the havoc wreaked on the nitrogen cycle. Through the use of fertilizers, the burning of fossil fuels and land clearing, humanity has doubled the levels of nitrogen compounds that can be used by living things. But those levels are more than can be efficiently absorbed by plants and animals and recycled into the atmosphere. These excess nitrogen compounds wash into fresh- and saltwater systems, where they produce dead zones by stimulating suffocating growths of algae. Since the global food system is based on aggressive use of fertilizer, restoring the balance of the nitrogen cycle poses a daunting challenge.

Even more devastating is what we've done to the water cycle. So large is human demand for freshwater that many great rivers like the Yellow in China and even the Nile in Egypt sometimes dry up before getting to the sea. When

to bounce back in many ways. Rain forests withstand some degree of cutting, for instance, but once forest fragments shrink beyond some unknown threshold, the entire system loses its ability to recover. PAGE refers to a recent study led by the University of Michigan's Lisa Curran, who contends that human activities such as logging may have doomed Indonesia's great dipterocarp trees, the anchor of its rain forests.

These trees reproduce by releasing huge masses of fruit in a synchronized fashion that is designed by nature to overwhelm the appetites of fruit and seedeaters and ensure that there are always some seeds left over to sprout. The strategy, called masting, worked for millions of years. Now, however, the forests in Borneo have been so reduced that humans and animals can consume all the dipterocarp fruit, with the result that no new dipterocarp trees are taking root in the areas studied by Curran and her colleagues. Since a host of creatures ranging from the orangutan to the boar are dependent on the dipterocarps, the trees' disappearance may ultimately doom Indonesia's rain-forest ecosystem. PAGE scientist Nigel Sizer of the World Resources Institute notes that similar problems associated with fragmentation loom over all but the largest remaining forests on Earth.

Halting the decline of the planet's life-support systems may be the most difficult challenge humanity has ever faced.

Government officials have long looked the other way because of close financial ties to companies cutting the timber.

#### MISSION IMPROBABLE

An ecosystem's intricate, interdependent webs of life are hard to restore once they have become frayed. The U.S. is learning this lesson in its multibillion-dollar effort to halt the decline of the Everglades, the "river of grass" that once covered 4,500 sq. mi. (11,700 sq km) in Florida. Having spent much of this century channeling, damming and diverting Everglades water for urban and agricultural use, state and federal politicians have watched with growing alarm as these alterations threw the ecosystem into a tailspin. Wading-bird populations have plummeted; sport and commercial fish catches have fallen; 68 of the Everglades' resident species, including the manatee and the panther, have become endangered; and the capacity of the system to store water has shrunk even as human demand for it grows.

With Florida's water supply and a \$14 billion annual tourist business in jeopardy, the Army Corps of Engineers put forward a \$7.8 billion plan in 1998 to undo many of its earlier projects and restore the slow-moving sheet of water that made the Everglades a natural wonderland. Billions more will be spent removing phosphorus from agricultural runoff, restoring habitats and modifying development plans to reduce stress on the system, but there is no guarantee that even these efforts will bring back the Everglades. The unsettling prospect that the planet's richest nation may not have the wherewithal to restore a vital ecosystem underscores a theme that runs through the U.N. report and should guide development decisions in the coming years: it is far less expensive to halt destructive practices before an ecosystem collapses than it is to try to put things back together later.

In their joint editorial announcing the findings of PAGE, the heads of the World Bank, the U.N. Development Program, the U.N. Environment Program and the World Resources Institute confirm their "commitment to making the viability of the world's ecosystems a critical development priority for the 21st century." These are sweeping words, but the jury on this commitment will be composed of the world's ecosystems. The planet itself will let us know, in the harshest possible manner, if our words are not being backed by action. ■

*Linden is the author of The Parrot's Lament and The Future in Plain Sight*

## HUMAN PROGRESS HAS OCCURRED AGAINST A BACKDROP OF LANDSCAPES TRANSFORMED TO SUIT THE NEEDS OF AGRICULTURE AND INDUSTRY

diverted water is returned to waterways, it often comes back laden with noxious chemicals and sewage. Moreover, the building of 40,000 large dams and many more smaller obstructions has converted most of the world's rivers into a series of interconnected lakes. Such a water system, like nothing seen since the end of the last ice age, has dire consequences for thousands of species adapted to free-flowing water. Human alteration of the water cycle also extends underground as farms and cities overtax aquifers, sometimes irretrievably damaging these reservoirs of groundwater as the land subsides and salt water intrudes.

#### WHERE'S THE BREAKING POINT?

Ecosystems are naturally resilient, but human impact can reduce their ability

The report specifies some common-sense steps in the right direction. For instance, governments can eliminate the estimated \$700 billion in annual subsidies that spur the destruction of ecosystems. In Tunisia, water is priced at one-seventh of what it costs to pump, encouraging waste. In the mid-1980s, Indonesia spent \$150 million annually to subsidize pesticide use. With access to cheap chemicals, Indonesian farmers poured pesticides onto their rice fields, killing pests, to be sure, but also causing human illness and wiping out birds and other creatures that ate the pests. When Indonesia ended the subsidies in 1986, pesticide use dropped dramatically with no ill effects on rice production.

Corruption offers another target. PAGE notes that illegal logging accounts for half the timber harvest in Indonesia.



## AGRICULTURAL LANDS

One-third of global land has been converted to food production, but three-quarters of this area has poor soil. So far, harvests outpace population growth, but the future is clouded by the loss of land to urban development, soil degradation and water scarcity.



### OUTLOOK

More than 40% of agricultural land has been badly degraded. Erosion, nutrient depletion and water stress spell trouble for such places as **Latin America**.

GRIM ——— GOOD

### Fertilizers and pesticides

Chemicals kill helpful creatures, taint groundwater and create dead zones in the oceans

### Soil degradation

Improper farming causes nutrient loss

### Irrigation

The process taxes aquifers, drains rivers and can lead to ruinous salt buildup in soil



TIME, APRIL-MAY 2009

## STUDENT CARD 2

## COASTAL/MARINE

Home to 2 billion people, coastal areas play a vital economic role and also feel the full brunt of human impact. Two-thirds of all fish harvested depend at some point in their lives on coastal wetlands, seagrasses or coral reefs, all of which are fast disappearing.



### OUTLOOK

The catch is declining for about one-third of major commercial fish. Collapsing fisheries will directly hurt 1 billion people, particularly in **Southeast Asia**.

GRIM ——— GOOD

### Pollution

Toxic and nutrient runoffs have produced a rash of algal blooms

### Overfishing

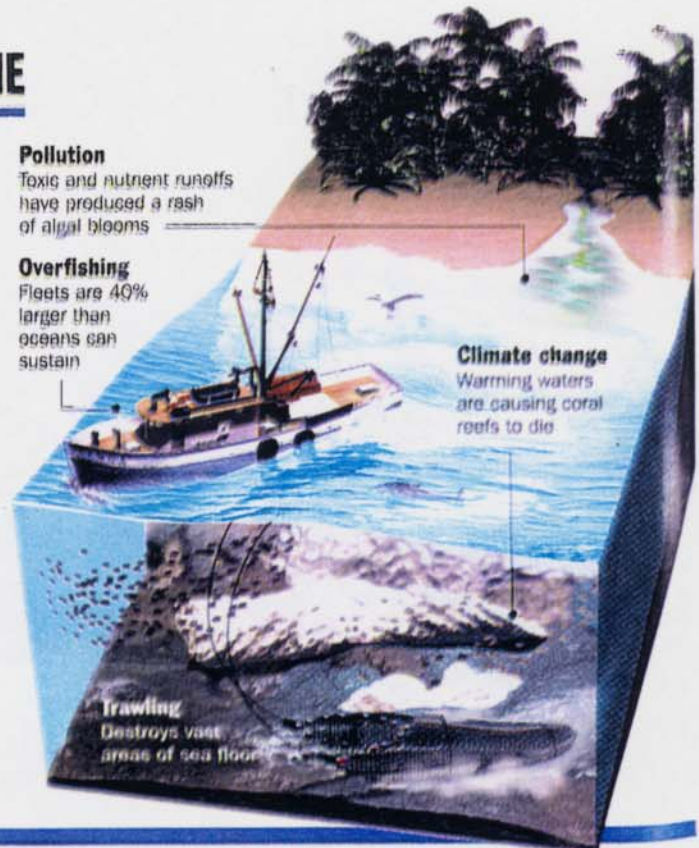
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### Climate change

Warming waters are causing coral reefs to die

### Trawling

Destroys vast areas of sea floor

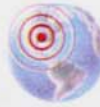


TIME, APRIL-MAY 2009




## GRASSLANDS

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### OUTLOOK

The **U.S.** has lost almost all its original grassland. Elsewhere, soil erosion and desertification are reducing the ability of the system to support livestock.

GHIM  GOOD



**Conversion**  
Large areas are being turned into farmland or used for urban development.

**Soil degradation**  
30% of the world's grasslands are affected by deteriorating soil.

## STUDENT CARD 4

## FORESTS

Home to two-thirds of all species, forests temper climate and capture and store water. Their timber has been a springboard for economic development. Forests store 40% of terrestrial carbon, and can slow the buildup of carbon dioxide in the atmosphere.



### OUTLOOK

Except for Russia and Canada, industrial nations have cleared almost all their original forests. Rain forests are also rapidly shrinking. Most at risk is the **Pacific Rim**.

GHIM  GOOD



**Fragmentation**  
As forest patches shrink, animals vanish.

**Fires**  
Are spurred by land clearing and climate change.

**Harvesting**  
In developing countries, logging rates are faster than tree growth.

## STUDENT CARD 5

### FRESHWATER

These are the most critical of ecosystems since all organisms need water to survive. Human water consumption rose sixfold in the past century, double the rate of population growth. People now use 54% of available freshwater, and additional demand will further jeopardize all other ecosystems.



#### OUTLOOK

Water scarcity may soon limit economic development, particularly in parts of **China**, where supplies are already inadequate to meet the needs of people, industry and agriculture.



GOOD

#### Pollution

Fertilizers, silts, sewage and other effluents have killed lakes and poisoned rivers

#### Conversion, diversion and fragmentation

Half the world's wetlands have been drained, destroying habitat

#### Overuse

So much water has been taken from rivers like the Colorado, Yellow and Ganges that they sometimes dry up before reaching the sea

#### Invasions

Introduction of nonnative species into an environment disrupts the existing balance. Zebra mussels, left, introduced into the Great Lakes from the Caspian, have clogged water-supply systems



Sources: U.S. and partners.  
Outlook ratings by FITE, based on RARE assessment

#### Extinction

Biodiversity is more endangered in freshwater than in any other ecosystem

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*Cooperative Extension System*



INTEGRATED PEST  
MANAGEMENT



**"Condition Critical"**

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